3-D APPLIED ELEMENT METHOD FOR STATIC NON-LINEAR SIMULATION OF PP-BAND RETROFITTED MASONRY

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ABSTRACT: Masonry, through its long history, is widespread used around the world and still remains a main building material in many places especially developing countries. However a poorly designed masonry is known as brittle and susceptible to the earthquake. To improve their seismic capacity, polypropylene band retrofitting technique method was purposed base on economic point of view and local availability of material and skilled labor. In this study, we proposed 3-D Applied Element Method as analysis tools to help understanding the polypropylene band retrofitted masonry behavior which will be benefit in the future design process. Unlike the previous version, 3-D Applied Element Method elements can be any rectangular prism which helps reducing the number of elements. Brick and mortar springs are represented by using different spring properties. Nonlinear constitutive law of the mortar spring employed the Gambarotta model which considers the material softening. Polypropylene band is modeled as beam element using conventional plastic constitutive law connected together with the masonry by elastic spring representing the polypropylene band to brick connector. The numerical simulation of non-retrofitted and retrofitted out of plane wallets shows that with the suitable selected parameter the behavior of masonry can be closely reproduced.

Key Words: Applied Element Method, 3-Dimension, Masonry, Retrofit, Polypropylene band

INTRODUCTION

Masonry along with timber structures are among the oldest structures that are still used nowadays. Masonry structures history can be tracked back as early as 8000-9000 B.C. near Lake Hullen, Israel (Lourenço, 1996). With its long history, abundance of material, ease of construction and the advantages in thermal property, masonry is widespread used around the world. This type of structure still remains a main building material in many places especially in developing countries (Paola, 2003). Despite its advantages as residential structure, masonry is known as brittle and unsuitable for construction of buildings in seismic zones (Tomaževič, 1999). The 1997 Umbria-Marche, 1999 Bhuj and 2003 Bam earthquakes shows that masonry is rather susceptible and a huge number of masonry collapses is found especially in the region where the poorly designed masonries are concentrated. Moreover, masonry collapse also results in high casualty because masonry material tends to break into the small debris and left insufficient void which reduce the chance of survival.

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